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ABSTRACT

Designed for use by students in vocational agricultural classes, this manual deals with tractor maintenance. Operation and daily care are the topics of the first section. Safety is also covered. In the final part of the manual, servicing the air cleaner and lubricating the engine are discussed. Both sections conclude with a quiz. (PLB)

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TRACTOR MAINTENANCE OPERATION & DAILY CARE

1. IMPORTANCE OF PRACTICING SAFETY

Most accidents are caused by carelessness on the part of the individual operator. Surveys on what causes accidents resulted in the following information: 88 percent of all accidents are caused by human error or carelessness, 10 percent are caused by faulty equipment, and 2 percent are caused by unavoidable happenings (lightning and other causes). Someone made this statement, "Most accidents don't just happen, they are caused by human error". Such general things as failing to study and follow instructions in the machine operator's manual, working when greatly fatigued or ill, or failing to keep the machine in good operating condition and to correct hazards that may cause accidents can all be classed as human error.

There are about 2,000,000 disabling injuries caused by accidents in the U.S. each year in the major industries, and about 290,000 of these injuries are in the agricultural industry. Agricultural machinery is the major source of all recorded farm accidents.

In order not to be "accident prone", the individual must become safety conscious if safety habits are to be developed. If something is being done dangerously, a positive safety attitude may prevent an accident. Such an attitude will change the method to a safer procedure.

2. OPERATING THE TRACTOR SAFELY

A tractor is similar to any other moving vehicle, in two ways; it is not dangerous when operated properly, and it has a center of gravity. The weight of the wheel tractor is concentrated in front of the rear axle and midway between the rear wheels. The tractor will not likely tip over on a slope until the center of gravity is outside the near tire, unless it is turning. The centrifugal force on a tractor making a turn is outward; therefore, a tractor may tip over on the side while making a turn at a high speed. A tractor may be upset at eight miles per hour on level ground. Several safe operational practices are illustrated as follows:

a. The drawbar is used to pull a heavy load. The tractor may tilt backward if the axle or seat bracket is used. If the lift attachment hitch is positioned too high the same result may occur. The drawbar and hitch attachment are unsafe to ride upon.

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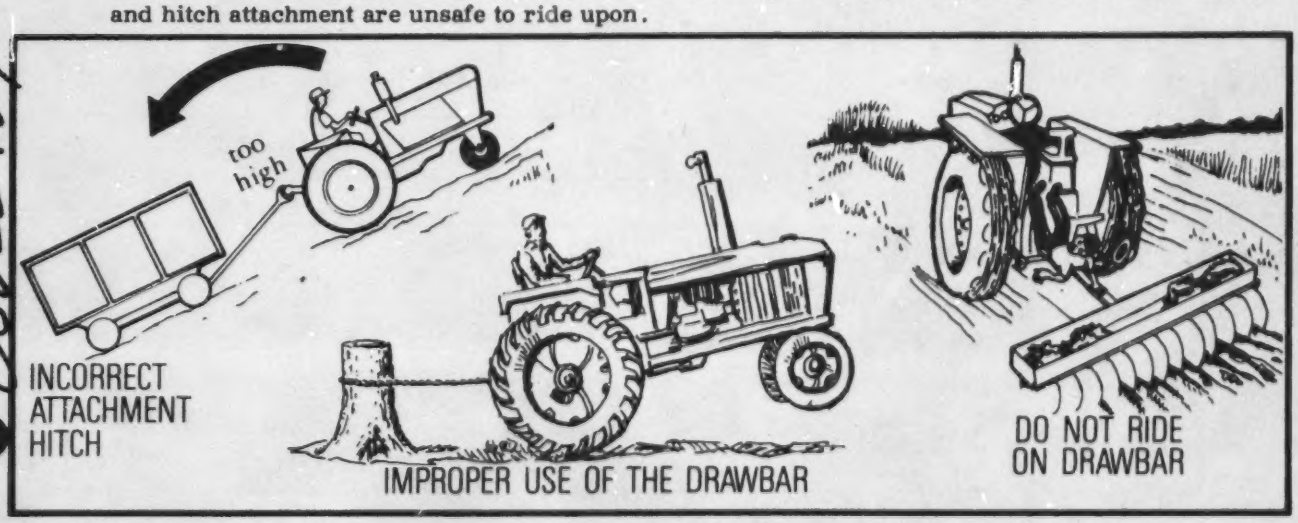
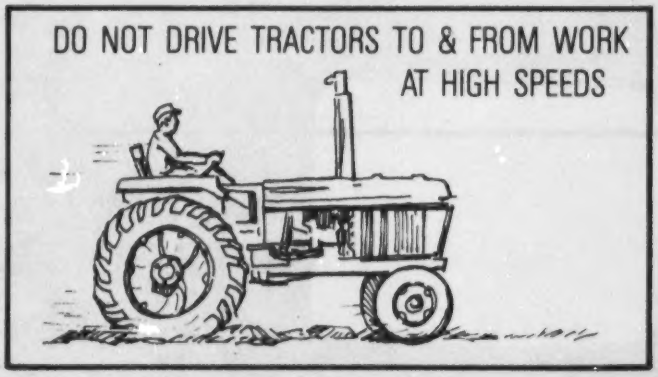
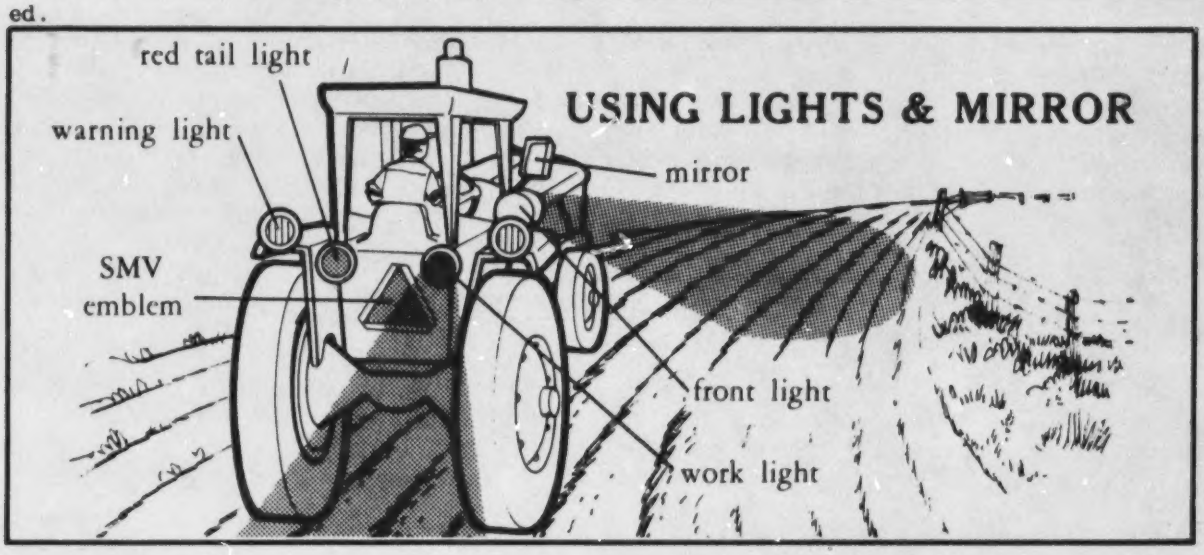
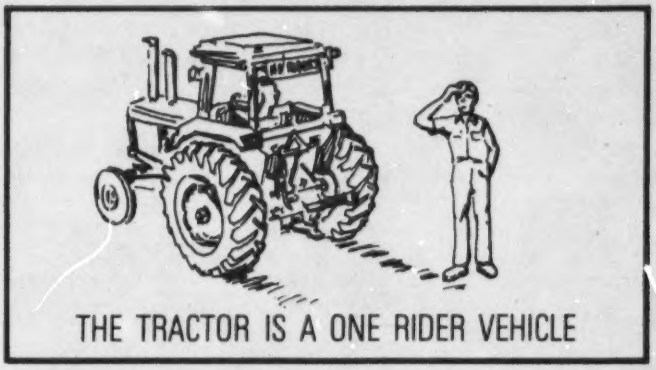


b. The tractor should be driven at moderate speeds. Many tractor upsets are caused by high speeds to and from work. Heavy and high speed traffic should be avoided. It pays to haul the tractor rather than have it exposed to traffic conditions. Any slow-moving vehicle should display the slow-moving symbol day and night when traveling on roads or highways. About 2/3 of all slow-moving vehicles that are in collisions are hit from the rear by fast moving vehicles. Tractor lights should be used properly and the operator should see that mirrors are properly adjusted.

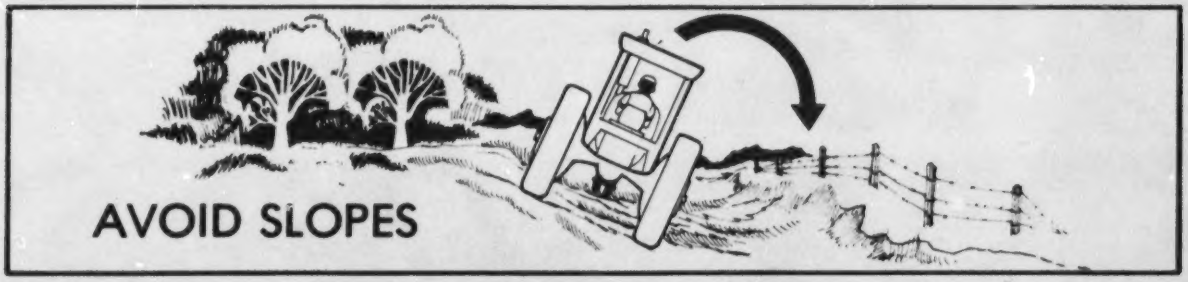




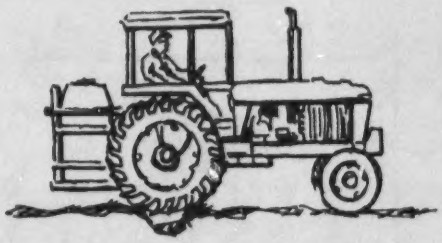
c. The tractor should be considered a one-rider vehicle. The operator should be the only person on the tractor when it is in operation.



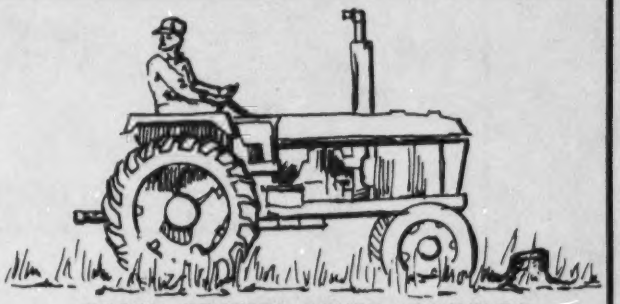
d. If possible avoid tractor operation on ditch banks. The tractor should only be driven across ditches that have gradual slopes. Steep banks on ditches may cause the tractor to tilt backwards or sideways.



e. The tractor should be driven carefully over narrow ditches and through tall weeds and grass. A small ditch, hole, or bump, such as a log stump or rock may cause the tractor to tilt sideways or even throw the operator off the tractor. The tractor should also be operated with utmost care in mud and on slippery ground. Wheels stuck in the mud can cause an accident since the chassis may revolve around the axle when power is applied.

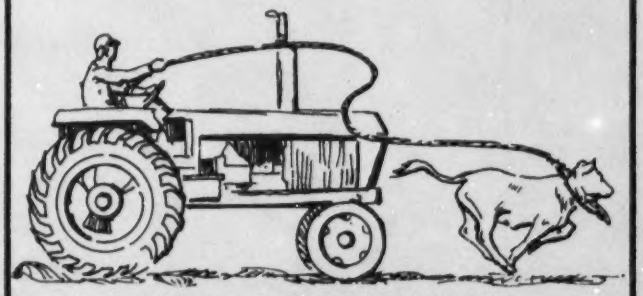


DO NOT DRIVE FAST OVER NARROW DITCHES



HIDDEN OBJECTS CAUSE ACCIDENTS

f. Use the tractor for only those jobs it is designed to do. Running errands and playing cowboy may cause a serious accident.

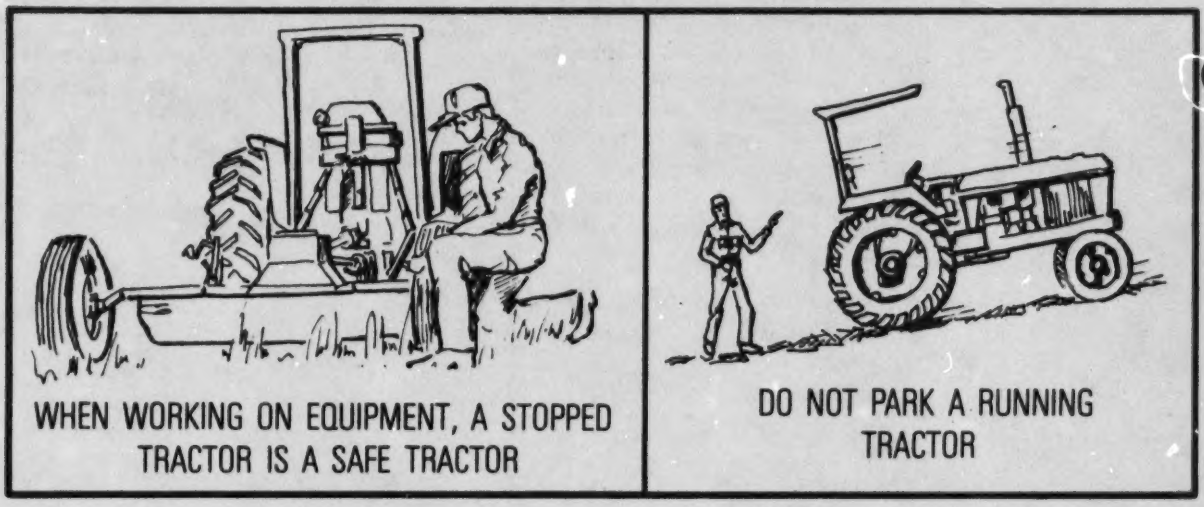


IMPROPER USE OF TRACTOR

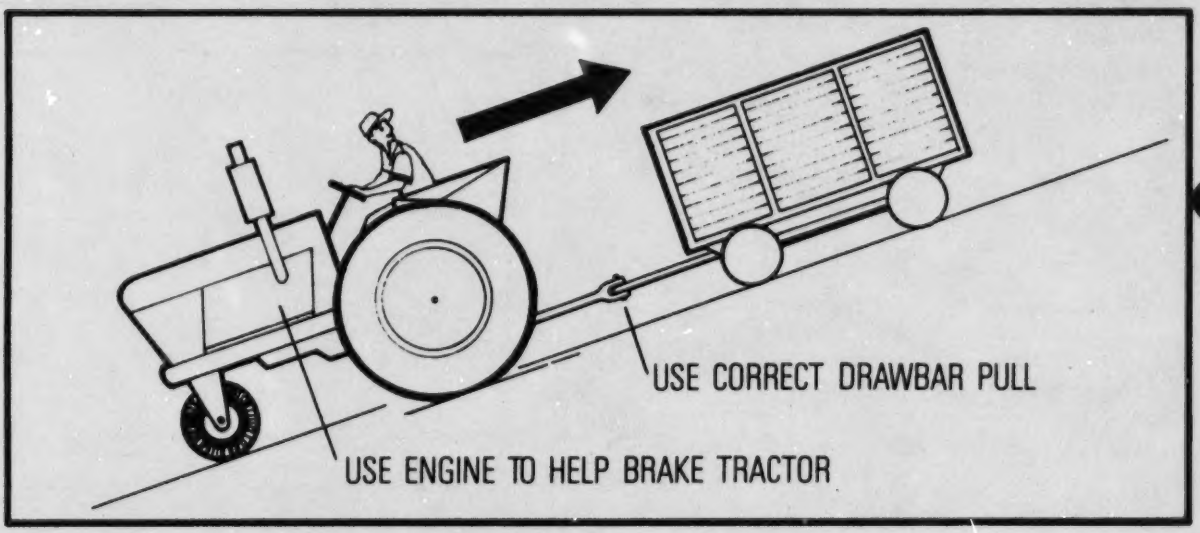
g. Use rear wheel weights when using a front-end loader or similar equipment to avoid having the tractor tip over. Rear wheel weights not only aid in balance but add traction to prevent slippage.

REAR WHEEL WEIGHTS HELP BALANCE THE LOAD

h. The engine should be stopped and brakes engaged when working on the tractor or attached equipment. These precautions along with never parking a running tractor may prevent an accident from occurring.



i. The tractor should be kept in gear and the speed reduced when going down steep slopes or hills. The tractor engine aids in braking the tractor. Using the correct hitch pin and locking device is also important.



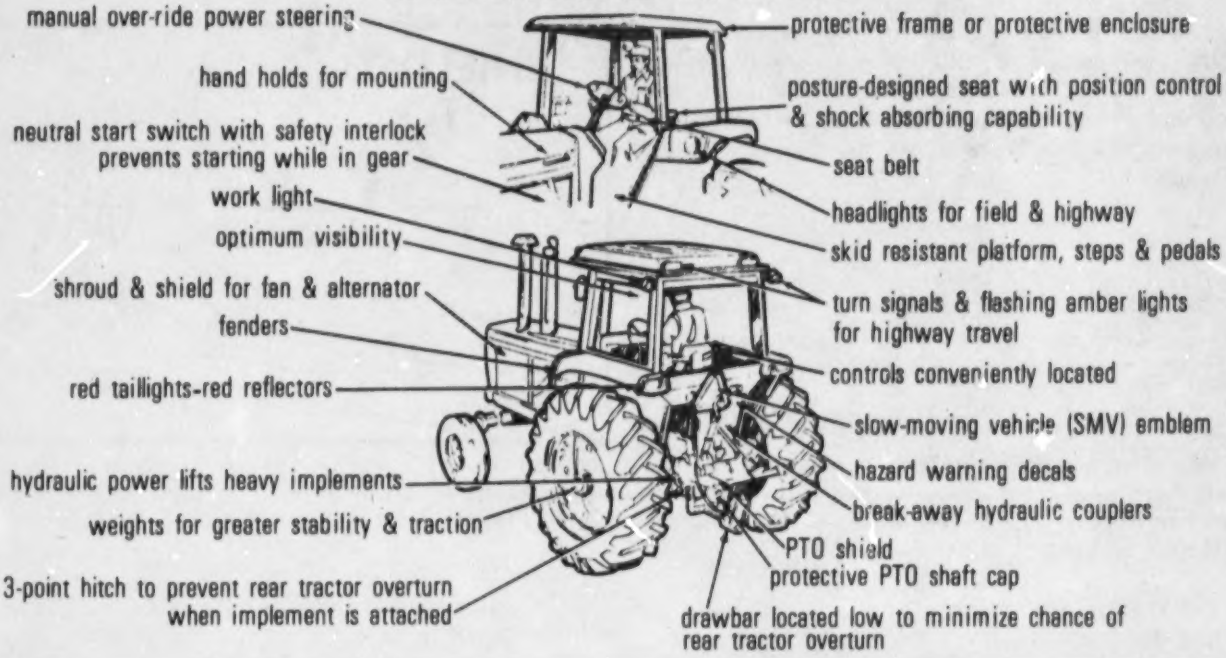
j. Other general safety rules for tractor operation include: becoming familiar with the correct starting procedure, proper dress, eye protection, proper refueling procedure, checking for safety guards in place, and using common sense.

Most tractor and equipment accidents are caused by the operator failing to recognize the approaching danger or by the operator's carelessness. Accidents may be reduced or eliminated completely if the operator observes the safety rules for operating a tractor.

The best time to form correct and safe operation habits is when the operator is learning to operate the machine. Usually the operator's manual is studied at this time. The manual warns against unsafe habits and explains how the operator may develop safe practices.

Each year new safety devices are designed and placed on the tractor and tractor equipment. These safety devices are designed to protect the operator and others. If they are removed or made inoperable, the chance of being injured becomes greater. Actually, the best type of safety device is the operator. The following illustration identifies typical tractor safety features.

TYPICAL SAFETY FEATURES AVAILABLE ON MOST NORTH AMERICAN MANUFACTURED TRACTORS


manual over-ride power steering
hand holds for mounting
neutral start switch with safety interlock prevents starting while in gear
work light
optimum visibility
shroud & shield for fan & alternator
fenders
red taillights-red reflectors
hydraulic power lifts heavy implements
weights for greater stability & traction
3-point hitch to prevent rear tractor overturn when implement is attached
protective frame or protective enclosure
posture-designed seat with position control & shock absorbing capability
seat belt
headlights for field & highway
skid resistant platform, steps & pedals
turn signals & flashing amber lights for highway travel
controls conveniently located
slow-moving vehicle (SMV) emblem
hazard warning decals
break-away hydraulic couplers
PTO shield
protective PTO shaft cap
drawbar located low to minimize chance of rear tractor overturn

3. DRIVING THE TRACTOR

Starting the Movement - The foot brakes must be unlatched before the tractor is put in motion. There are several different types of latch releases. Some of the most common are: pull rod, lever, and toetrip. Some tractors have both brakes on one side, whereas others have a brake on each side of the engine. The PTO must be disengaged before starting the engine.

Idle the engine before engaging the clutch and shifting gears.

Disengage the clutch so that all power will be removed from the transmission, thus stopping the gears from rotating.

Shift the gear to the desired speed and engage the clutch. The rate of engine speed (quickness) for engaging the clutch will depend on the type and condition of tractor and the position the tractor is in at the time of movement. Clutches grab on some tractors, causing a sudden lunge forward. Engage the clutch easily.

A power shift can be shifted with the tractor in motion or on-the-go. The change in gear ratio is by a system of brakes and clutches that function together by hydraulic pressure. Change the gears one at a time.

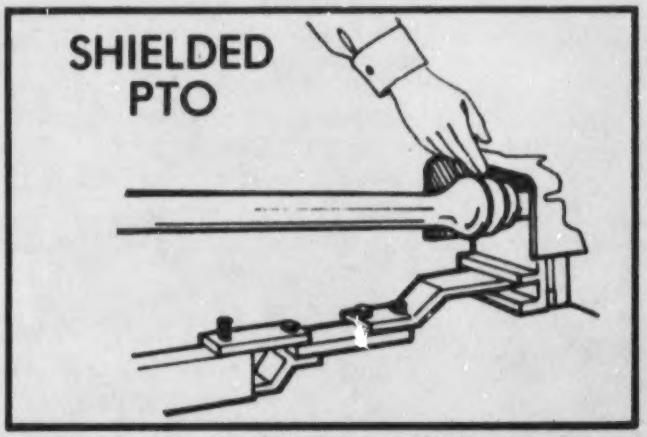
If the tractor is equipped with a hand-shift transmission, the gears should not be shifted while the tractor is in motion. Some tractors are equipped with "gearshift stations", therefore, gears can be changed in the station while the tractor is in motion. The clutch disc and the transmission shaft must be stopped completely on most hand-shift tractors in order to avoid gear damage.

The tractor steering system is similar to an automobile. On most farm tractors a steering wheel is used to guide the front wheels. However, a tractor is equipped with individual brakes to assist the steering. A short turn may be made by braking one wheel.

Stopping the Movement - Retard the throttle to reduce the engine speed. Press down firmly on the clutch pedal to disengage the clutch. Shift the gear to the neutral position. The brakes may aid in bringing the tractor to a complete stop. The brakes are locked by pressing the brake pedal down. The speed-control lever should be set at fast idle if the engine is left running. If the driver is to dismount from the tractor, the engine must be stopped.

4. SPECIAL SAFETY PRACTICES

Many accidents are caused by the power takeoff (PTO). The most common accident is getting caught by the PTO shaft or rotating machine shaft. On some occasions an attached shaft will break or become disconnected and begin swinging dangerously behind the tractor.



To help eliminate PTO accidents master shields and tunnel shields are provided by manufacturers. Master shields are used on tractors to protect the operator and others from coming in contact with the short PTO shaft. In order to completely eliminate the danger of coming in contact with the PTO shaft, a tubular guard shaft must be used over the stub shaft.

Tunnel shields are used on the equipment shaft. This shield must extend from the equipment to the stub shaft of the tractor. Such shields may be nothing more than metal or other hard material guards. Some shields completely surround the shaft, whereas others are U-shaped covers supported by braces. Many of the integral-journal (tube) shields are made of plastic and are supported by bearings that cause them to rotate free of the main shaft.

Human factors that can prevent PTO accidents are as follows:

a. Disengage the PTO before stopping the engine and dismounting from the machine. Keep the PTO disengaged when servicing or repairing the machine.

b. Operate the tractor only when the master shield is in place. It may be necessary to disconnect the shield when changing equipment, but it should be replaced immediately.

c. Check the integral shield by rotating it by hand when the machine is stopped. Repair the shield if it or the bearings have been damaged.

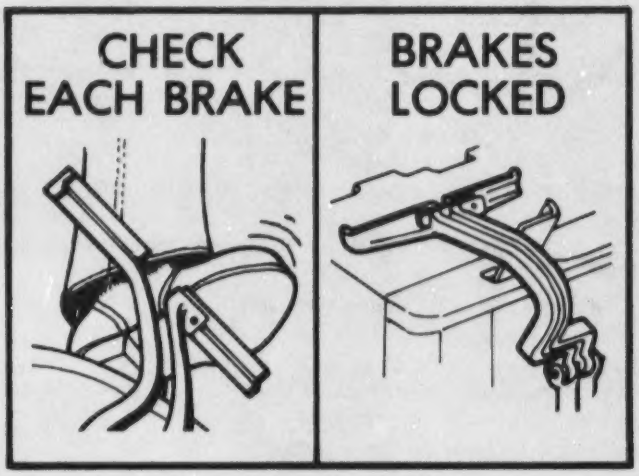
d. Tunnel shields will not operate properly if they are out-of-line. Align the shield and bolt securely in place.

e. Refrain from stepping over a rotating shaft, even though it is protected by a cover.

f. Properly phase or align the shaft universal joints if necessary. Some shafts cannot be reassembled improperly. However, some can be improperly assembled; therefore, they must be assembled in phase.

g. One cause of shafts separating is that they fail to overlap enough and when one part of the unit (tractor and equipment) is higher than the other, the shaft comes apart. Therefore, use a shaft recommended for the proper connections.

Many accidents are caused by incorrect brake operation. Check the brakes before putting the tractor in motion and after the tractor begins to move slowly. If the tractor is equipped with power brakes, press each brake pedal to check the distance of travel. Lock the brakes together and operate the tractor slowly and use the brakes to determine if both are functioning the same. Use the operator's manual or shop service to make adjustments.



When braking the tractor observe the following:

a. Use the individual wheel brakes to assist in steering the machine. If a short right turn is to be made, press the right wheel brake. This action slows the forward movement, resulting in a shorter turn.

b. Lock the two brake pedals together when road driving the tractor. Pressure on the brake may upset the tractor at high speed.

c. If fatigued or ill, begin braking the tractor or machine a few seconds sooner than when feeling fit. For example, when traveling 20 miles per hour, the machine will move about 7 feet for each 1/4 second.

d. Check the operator's manual for proper braking methods when going down hill. The tractor may "freewheel", which means the engine will not help brake the downward speed.

The use of lights and reflectors requires some attention by the operator. Safety practices to observe are:

a. When driving tractors and self-propelled machines on public roads at night, use the warning lights. These lights should be visible from both front and rear and mounted at the same level.

b. When making turns, use the proper turning signal (visible from front and rear).

c. Most tractors and powered machines are equipped with red tail lights and reflector, work light, two amber warning lights on the rear, and two front lights.

d. Use reflectors on equipment that is moved at night. If the equipment extends beyond the width of the tractor rear wheels, both flashing amber lights and reflectors may be used. This type of lighting system will require a special lighting system mounted on the equipment. Many types of reflectors and movable lamps are available for towing equipment.

e. Use the machine on public roads at night only when both headlights are functioning. Set the lights so that they do not blind approaching drivers but are aimed properly in the path of the machine.

f. Use mirrors that are designed for the machine. They may not be considered standard equipment, but they are very valuable as a working and safety device. If the machine is not equipped with mounting brackets, construct them to eliminate vibration and being hit by an obstacle and yet give adequate rearward visibility.

5. FIRE SAFETY

Tractor and equipment fires may be caused as follows:

a. Electrical shorts in the electrical circuits.

b. Fuel leaks due to loose or cracked lines.

c. Trash accumulation, dust, and chaff on the machine.

d. Broken or cracked sediment bulb. Most machines are equipped with metal or heat-treated glass bowls.

e. Malfunction of the carburetor on a gasoline unit.

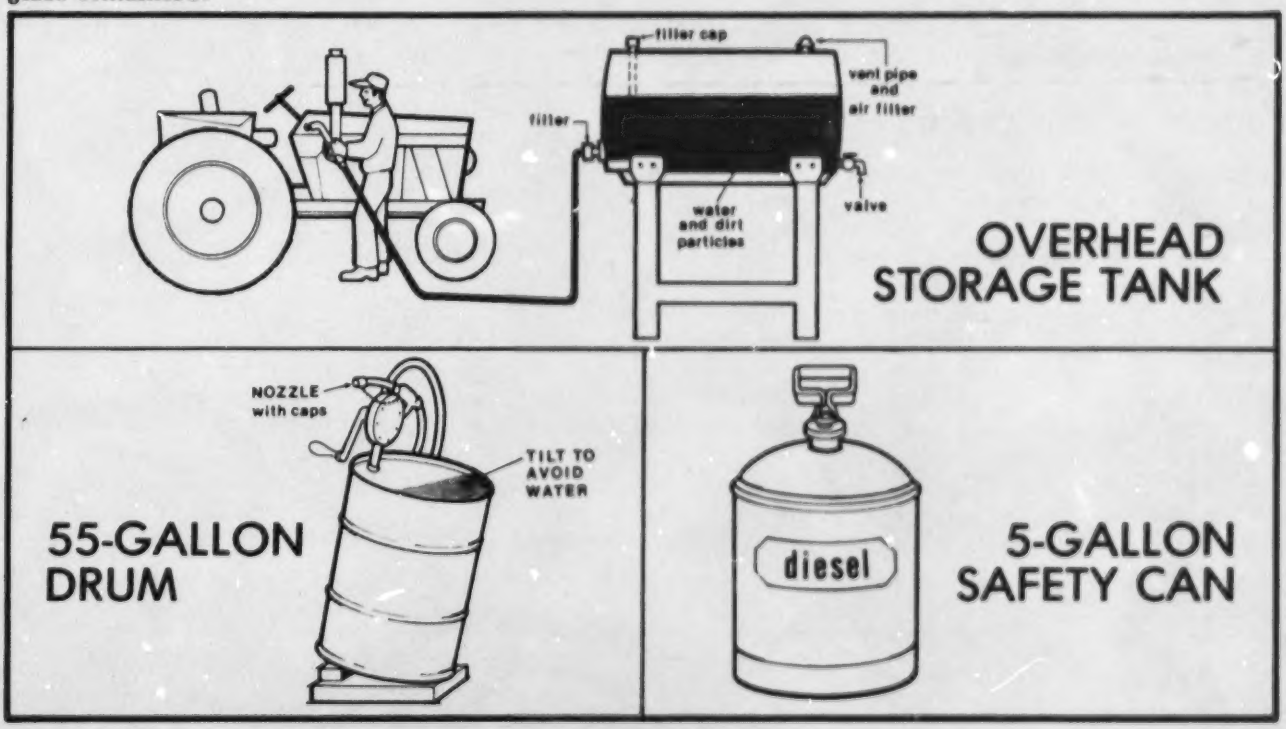
f. Sparks from the exhaust.

g. Careless machine operators. Smoking and allowing the engine to operate (run) when refueling are considered two very dangerous acts.

6. FUEL SAFETY

Storing and Handling Diesel - Diesel overhead tanks should be placed at least 40 feet from the closest building. The National Fire Protection Association states that flammable vapors are released due to fuel spills while refilling machines and the storage tank. Diesel fuels may be stored the same as gasoline, in underground or overhead tanks, small drums, or safety cans. The containers should have the similar safety features as found on the gasoline containers, even though the fuel is not considered as flammable as gasoline. Most overhead diesel tanks are equipped with a vent pipe and filler cap. They do not have a special vapor pressure valve.

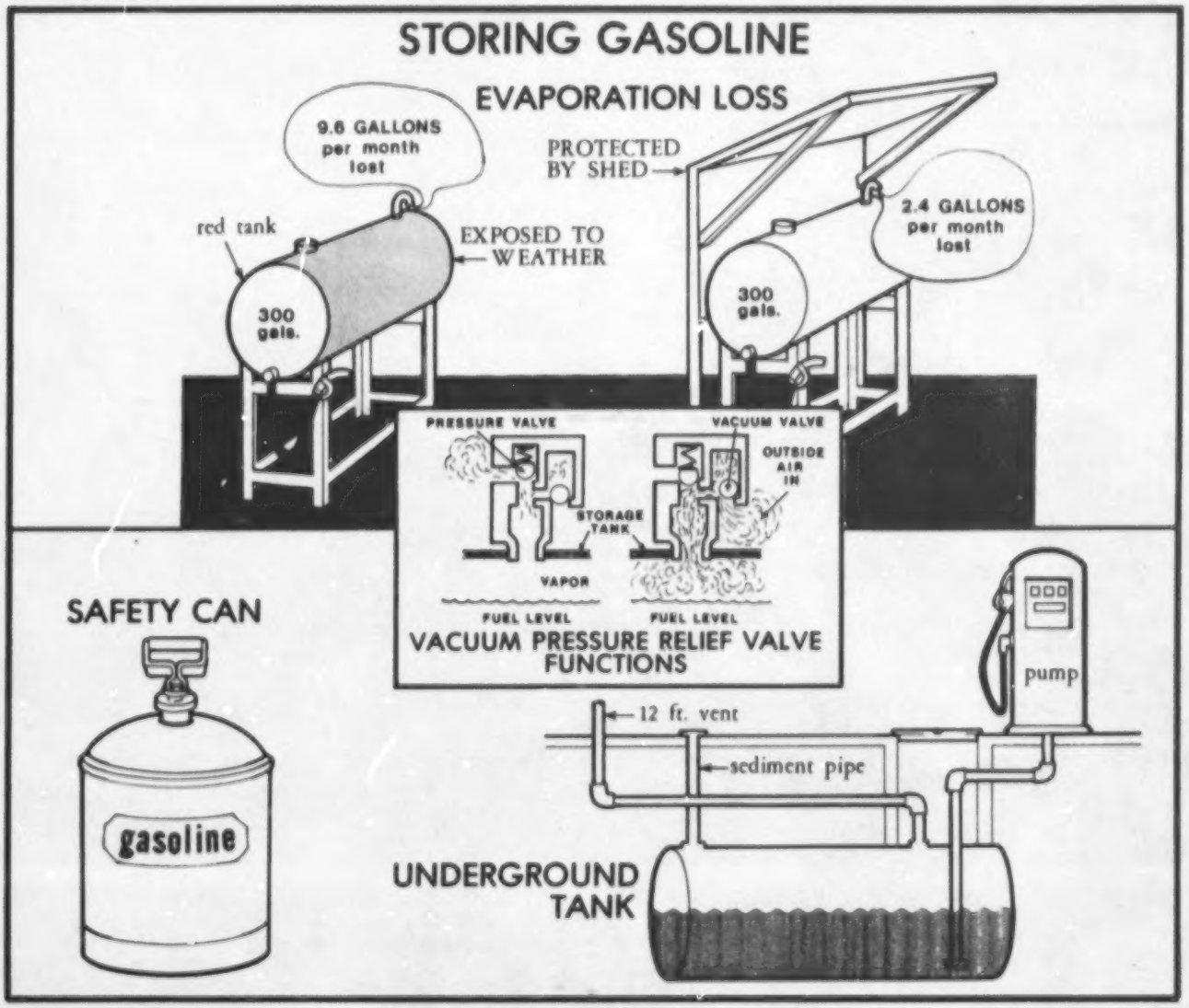
Kerosene can also be stored in the same manner as diesel fuel. It is not as flammable as gasoline, but it will give off flammable vapors when heated above 100 degrees F. Like gasoline and diesel fuel, it should never be stored in a closed building. An open shed should be used. Also, it should never be handled in open or glass containers.



Storing and Handling Gasoline - Above ground gasoline tanks should be located as far as practical from buildings. The National Fire Protection Association recommends a minimum of 40 feet from the closest building. Tanks must be equipped with pressure-vacuum relief valves to prevent dangerous vapor pressures. A safety valve between the hose and tank is a must. It stops the flow of fuel in case of fire. The NFPA standard is for all above ground tanks to be equipped with safety valves that close automatically in case of fire. An underground tank with a pump provides the safest storage. Rust is a problem on underground tanks; therefore, care must be taken not to damage the tank coating when installing it. Usually an asphalt tar or mastic coating is used. Place an underground tank and pump on a sloping and well drained area. This type of tank can be located within about a foot from the nearest building.

Locate smaller containers (55 gallon drums) of gasoline at least 40 feet from buildings. Store the drums outside closed buildings. Paint name of fuel on container. Never approach drum area with any flame that may ignite gasoline. Use pump to remove fuel from drum. Use an approved safety can to carry gasoline indoors. In this case, indoors means open ventilation. Most safety cans have a spring or valve to prevent the escape of vapors.

All gasoline stored above ground should be stored outside of buildings but placed under a shed. The tank should be painted white with gasoline printed on the front or side. White tanks stored under sheds lose much less gasoline than colored tanks exposed to the sun's rays. For example, a 300-gallon red tank will lose 9.6 gallons per month compared to a loss of 2.4 gallons per month from a white 300-gallon tank stored under a shed.



Storing and Handling LP-Gas

The LP-gas tank should be placed a minimum of 50 feet from the nearest building. It should be 20 feet or more away from other fuel storage tanks. This distance gives adequate space for machines to travel between other structures and the tank.

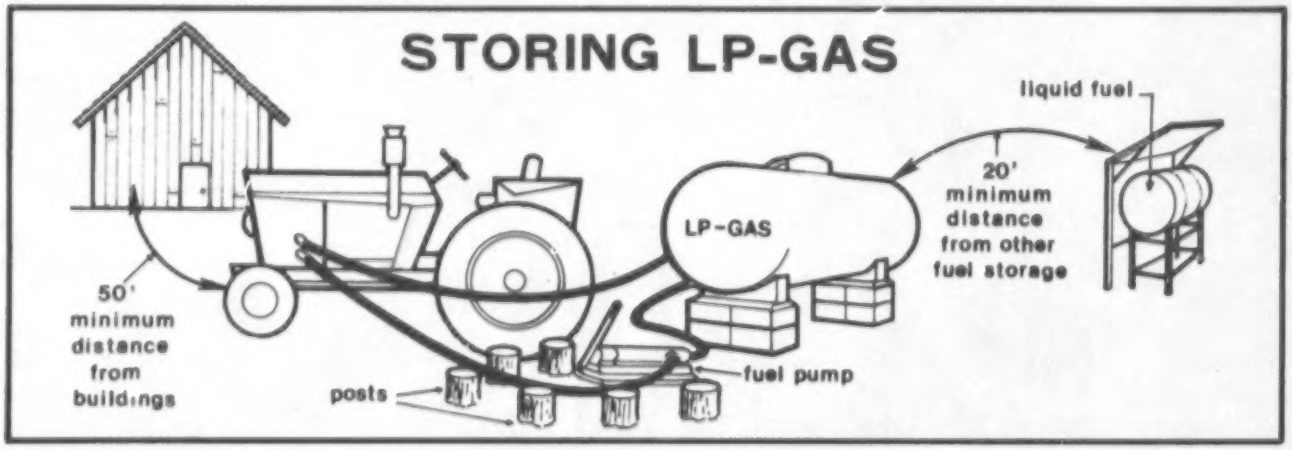
Tanks are usually placed above ground in order that leaks can be readily detected by using a soap suds solution. However, LP-gas tanks can be installed underground. Very rigid standards have been established by the National Board of Fire Underwriters regarding standards for storage tanks. A name plate is found on each storage tank, giving the tank pressure in pounds per square inch, the size in gallons of the tank, the name of the supplier, and whether the tank is to be used for underground or above ground purposes.

Some precautions to observe when refueling with LP-gas are:

a. LP-gas is much heavier than air; therefore, refueling should not be over low places. Refueling should always be done outside of buildings. Use the vapor return line to equalize tank and machine pressure. The machine tank can be filled without vapor escaping to open air.

b. Fill the machine (tractor or truck) tank only about 3/4 full. If the relief is forced to open, dangerous vapor escapes. Both automatic tank gauges and manually operated gauges are found on tractor tanks. The manual fixed tube-type gauges are operated by opening while the tank is being filled and closed after filling. Never permit any gauges to remain open after filling a tank.

c. Refuel an LP-gas tank when the engine is cool and stopped. Check the ignition switch to see that it is in the off position, and refrain from smoking until all vapors have been ventilated away.



7. THE IMPORTANCE OF TRACTOR MAINTENANCE

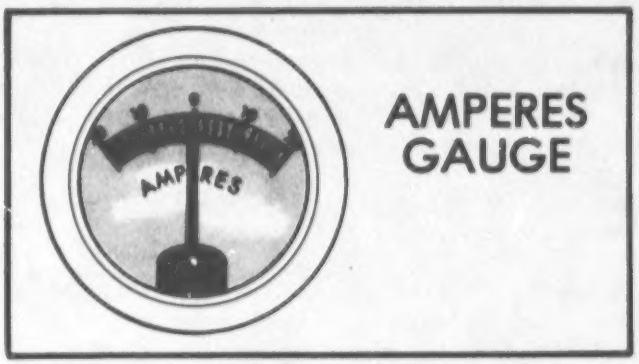
A tractor is designed to give long and satisfactory service if it receives the proper care throughout its useful life. Many tractors remain in operation for twenty-five years and even longer.

In order for a tractor to give long service it must receive the proper daily care when it is being used. The best guide to follow for a good maintenance program is the operator's manual. This explains which parts need to be checked and serviced, according to the length of time the tractor is in operation. It may point out maintenance practices that should be observed at the beginning of each operational day.

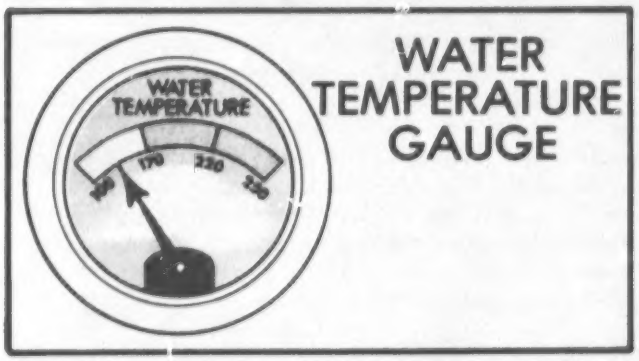
8. OPERATION DEVICES WHICH PROTECT THE TRACTOR

The tractor manufacturer provides instructions, instruments, and gauges to protect the machine while it is in operation. These devices identify troubles that appear in vital parts of the engine. The instruments and gauges relay messages, and a competent operator watches them while driving the tractor. Some of the gauges and their functions are as follows:

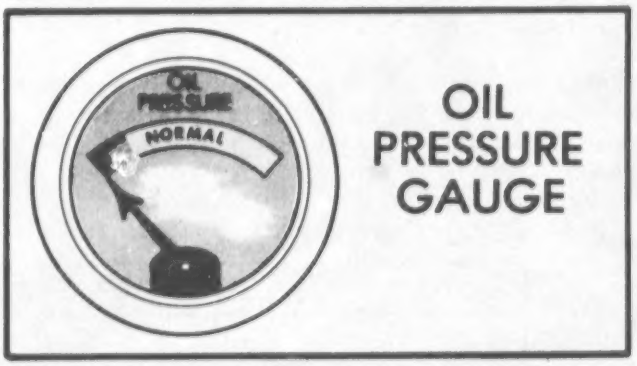
The ammeter indicates the current flowing from the battery. This dial points out any electrical problem in the circuits.



The heat indicator shows the temperature of the liquid in the cooling system.



The oil gauge dial indicates the oil pressure which is regulated by the circulation of the oil.



The RPM, MPH, and Hour Use gauge shows: the revolutions per minute of the engine and PTO, field or road speed, and the number of hours of use.

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Tractors are equipped with special air cleaners, brakes, lights, guards, bearings, grease fittings, seals, wheel weights, filters, and special gear ratios to make them among the most protected machines in operation. Yet, many tractors are disabled or destroyed through unnecessary wear, mechanical problems, collisions, breakage, and plain crack-ups.

9. SPECIAL CARE PRACTICES

All tractors have certain parts that need daily attention. Most of these parts are checked every ten hours (daily) the tractor is operated. Under certain conditions some parts of the tractor are checked every five hours. For example, a tractor operating in mud or on a very dusty location should be checked more often than one operating under normal conditions.

A new or overhauled tractor requires a different kind of daily care from one that has been in service for several months.

A new or overhauled tractor is operated at less than one-half load at full throttle for the first ten-hour period. For the second ten hours, it is operated at one-half load. The new or overhauled tractor should be operated at about one-half load for five to six ten-hour periods before operating at a full load.

The engine on a new or overhauled tractor should not be idled for a long period of time. Damage may occur to the cylinder walls or rings due to insufficient lubrication. A corrected fast idle speed should eliminate overspeeding of the engine. A new or overhauled engine should not be overspeeded.

Before a tractor is put under a full load, it should be allowed to warm-up. The warm-up period is most important if there is a high moisture content in the air or if the weather is very cold. Even during warm weather, it is advisable to idle the engine a few minutes before operating the tractor at a full load. Much of the engine wear occurs between the time the engine is started and the time it reaches the proper operating temperature. It may take the tractor twenty to thirty minutes to reach a proper operating temperature of 180-190 degrees.

10. DAILY CARE PRACTICES

Transportation vehicles are usually serviced according to the miles in operation. Tractors are serviced according to the number of hours they run and the type of conditions they are operated under. Most of the same operating parts will be checked during each check period. The most important service periods and services performed are:

a. Periodic Lubrication:

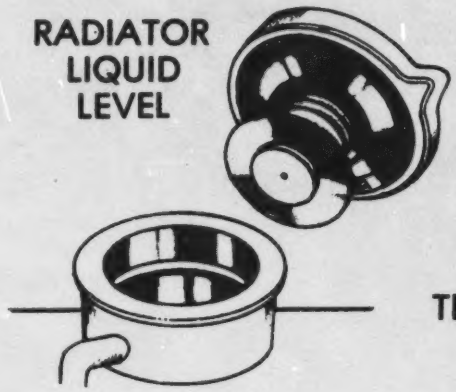
Hour Interval	Part
5	Air Cleaner
10	Steering and Lift Mechanisms
50	Clutch Throw-out Bearing
100	Engine Oil Change
250	Steering Gear Housing, Generator Bearings, Distributor
500	Repack Front Wheel Bearings
1000	Transmission Oil Change Torque Tube Oil Change Power Steering Reservoir

b. After each 10 hours of operation, check the following items: (1) crankcase oil level, (2) liquid in cooling system, (3) fuel tank level, (4) air cleaner, (5) tire air pressure, (6) broken or worn parts, loose nuts, and bent brackets, and (7) fan, generator, and water pump belts.

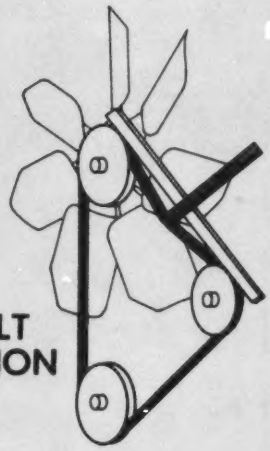
CHECK AFTER 10 HOURS:

CRANKCASE OIL LEVEL

RADIATOR LIQUID LEVEL

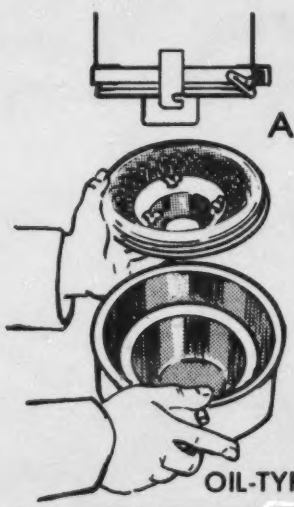


BELT TENSION



FUEL TANK FILLED AT END OF DAY

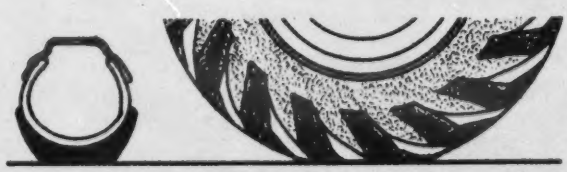
CLEAN AIR FILTER



OIL-TYPE

DRY-TYPE

TIRE INFLATION



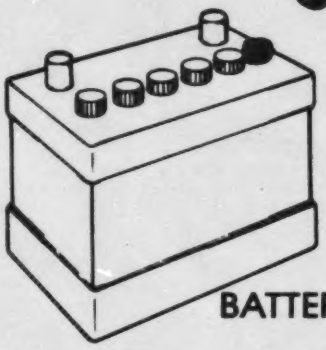
PROPERLY INFLATED TIRE

OVER-INFLATED TIRE

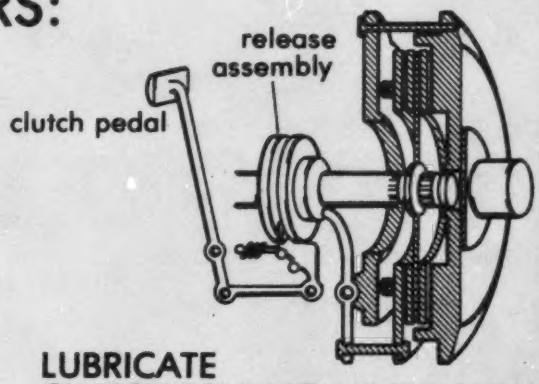
UNDER-INFLATED TIRE

c. After each 50 hours of operation, perform the following maintenance jobs: (1) check and lubricate fan shaft and water pump bearings according to manual directions, (2) drain crankcase oil and refill, (3) check hydraulic fluid filter and replace element if necessary, (4) check pneumatic tire pressure, (5) check radiator core, water pump, fan and generator belts, (6) check flexible rubber connections for fit and leakage, (7) check and tighten cylinder head bolts with torque wrench on LP gas engines, (8) check battery fluid level, (9) check and lubricate clutch release mechanism, and (10) check and service dry-type oil filter.

CHECK AFTER 50 HOURS:

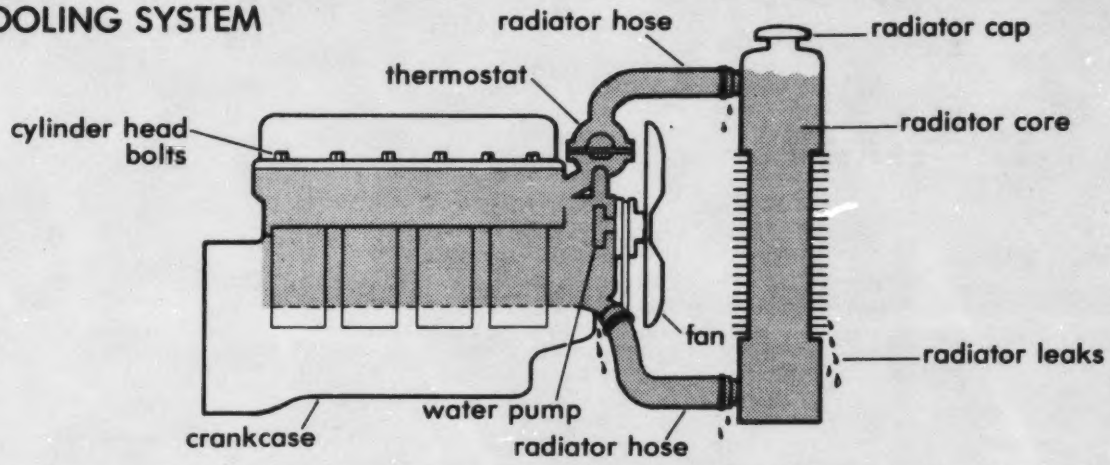


BATTERY FLUID

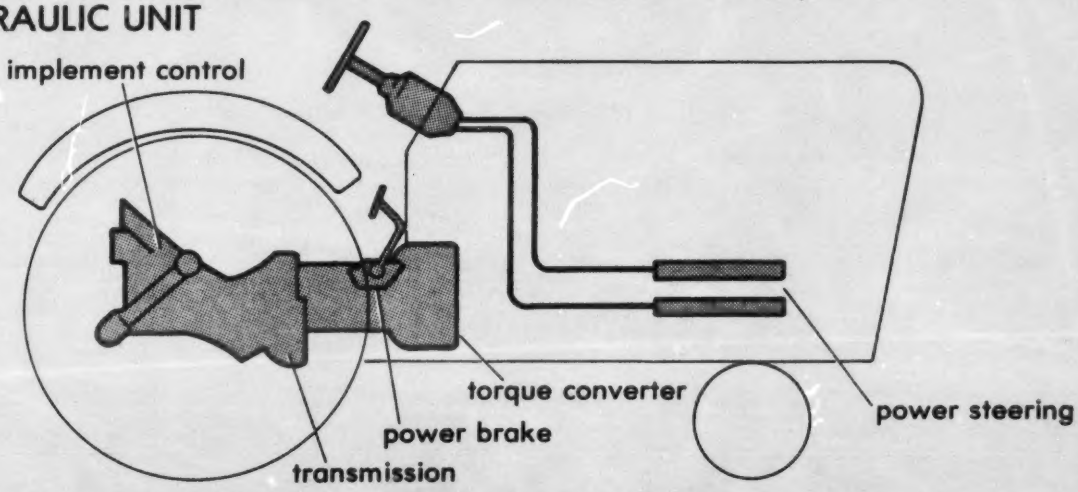


LUBRICATE CLUTCH RELEASE MECHANISM

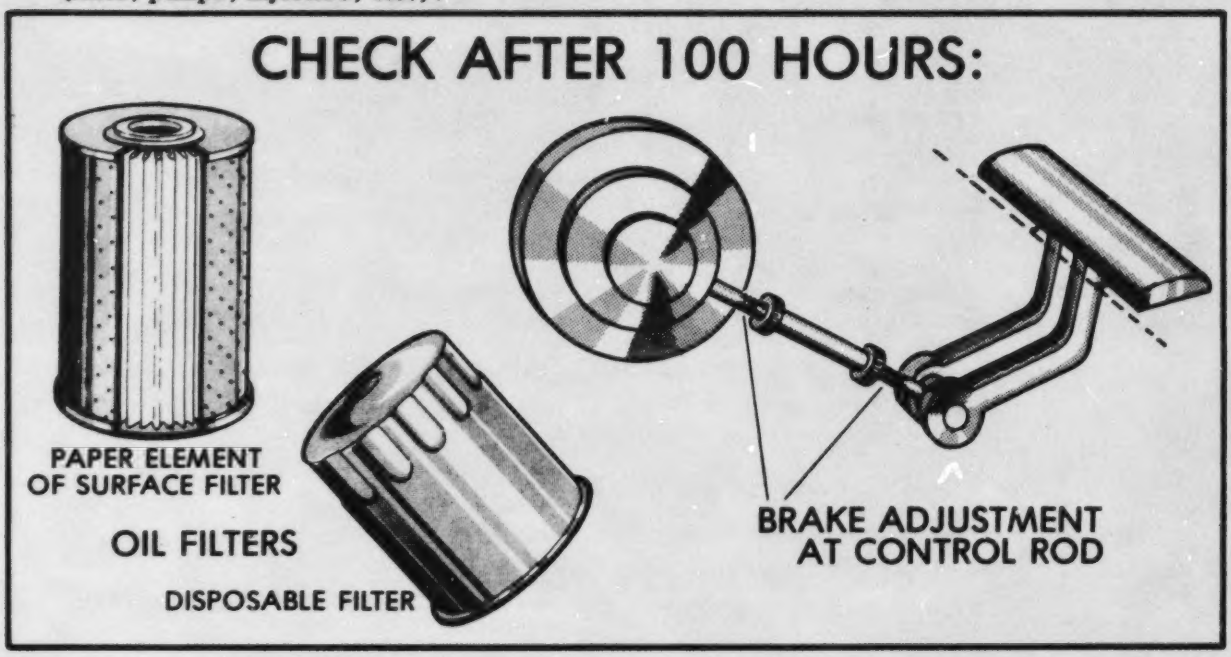
COOLING SYSTEM



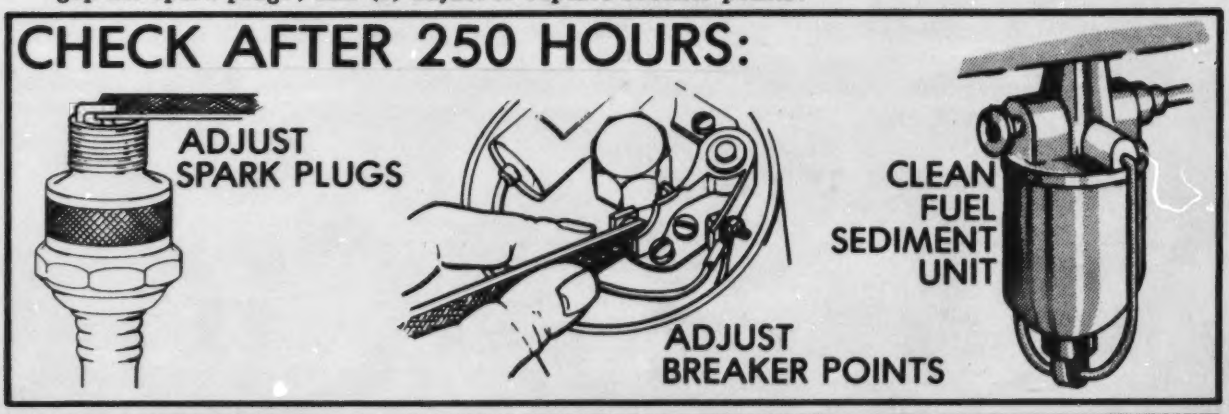
HYDRAULIC UNIT

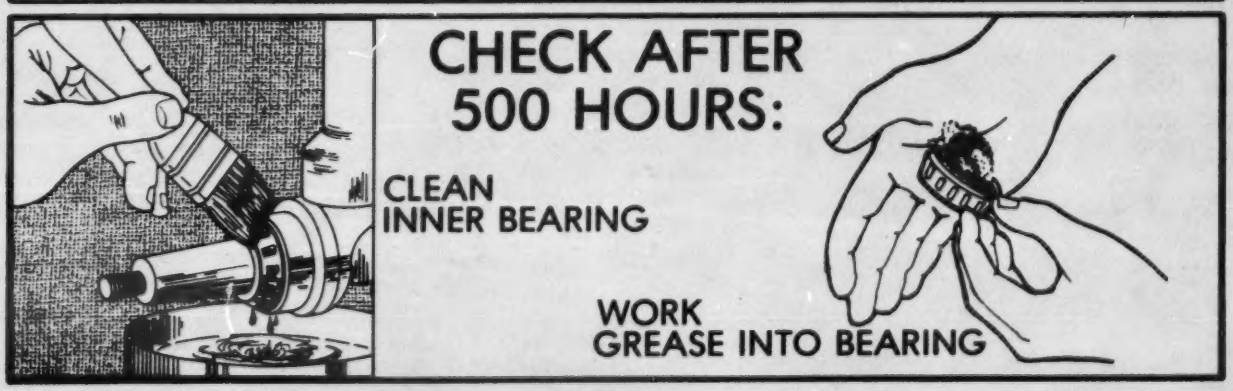


d. After each 100 hours of operation, complete the following maintenance jobs: (1) replace oil filter and change crankcase oil, (2) check and lubricate the clutch pedal, brake pedals, and clutch release bearings, (3) properly torque cylinder head bolts, (4) clean cylinder head breather caps, (5) check the crankcase breather and clean or replace it, and (6) check fuel system for leaks (lines, pumps, injectors, etc.).



e. After 250 hours of operation, complete the following maintenance jobs: (1) check and clean the sediment bowl, (2) drain and refill the crankcase, (3) clean hydraulic screen and replace filter, (4) change oil filter, (5) lubricate all points, (6) adjust brakes and clutch, (7) check, clean and gap the spark plugs, and (8) adjust or replace breaker points.





f. After 500 hours of operation, complete the following maintenance jobs: (1) repack the front wheel bearings, (2) charge hydraulic system oil, (3) change steering system oil, (4) drain and refill cooling system, and (5) check ignition timing.

g. After 1000 hours of operation, drain and refill the transmission, differential, and final drives. Make all necessary tune-up adjustments.

11. STORAGE AND USE OF TRACTORS

The tractor should be placed under a shed when it is not in use. Weather conditions such as high humidity, rain, sunlight, and dust storms can affect exposed tractor parts. Plastic, paint, rubber, and fiber tend to deteriorate when exposed to weather conditions.

Tractors are made to perform specific types of jobs, and they should not be used to perform work that will endanger the future use of the machine.

If a tractor is not cared for properly, the maximum horsepower will be reduced and the fuel consumption will increase. Proper care of a tractor will save money and avoid costly breakdown.

SUGGESTED STUDENT ACTIVITIES

I. Fill in the blank.

1. _____ percent of all accidents are caused by human error or carelessness.

2. _____ _____ is the major source of all recorded farm accidents.

3. A tractor is similar to any other moving vehicle, in two ways; it is not _____ when operated properly, and it has a center of _____.

4. Tractor brakes should be _____ together when road driving.

5. Any slow-moving vehicle should display the slow-moving _____ day and night when traveling on roads and highways.

6. _____ and allowing the engine to _____ when refueling are careless mistakes which could result in fire.

7. Above ground gasoline tanks should be located at least _____ feet from the nearest building.

8. White gasoline storage tanks located under _____ lose much less gasoline than colored tanks exposed to the sun's rays.

9. LP-gas tanks may be checked for leaks by using a _____ _____ solution.

10. The instruments and gauges on tractors relay _____, and a competent operator watches them while driving the tractor.

11. The ammeter indicates the _____ flowing from the battery.

12. A new or overhauled tractor should not be operated at _____ _____ immediately.

13. Consult the operator's _____ in making adjustments and performing maintenance jobs.

14. Proper care of the tractor will save _____, and avoid costly _____.

15. The tractor should be placed under a _____ when not in use.

II. Discussion Questions

1. Discuss the following as to safety and proper procedure:

a. drawbar -

b. speed -

c. riders -

d. terrain -

e. rear wheel weights -

f. typical safety features -

g. driving the tractor -

h. PTO -

19

i. brakes -

j. fuel -

2. Identify operation devices designed to protect the tractor.

3. Discuss daily and routine maintenance practices.

20

NOTES

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V. A. III
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TRACTOR MAINTENANCE
SERVICING AIR CLEANER & LUBRICATION

1. THE PURPOSE OF THE AIR CLEANER

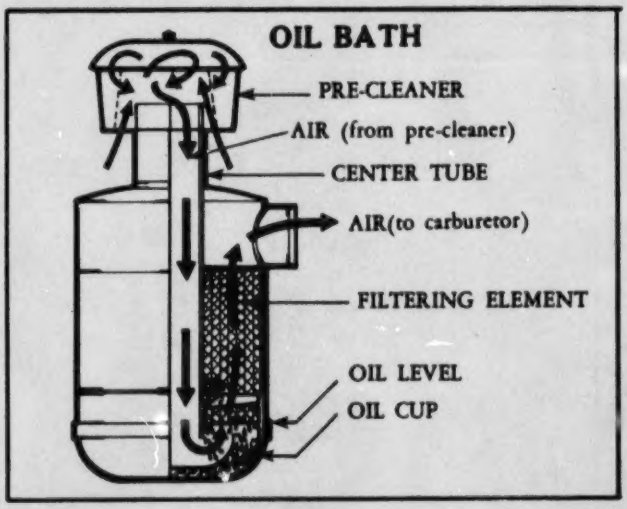
The air cleaner is one of the most important parts of standard equipment found on a tractor. It furnishes clean air to the engine by preventing dust, chaff, and other foreign material from passing through the carburetor, manifold, intake valves, and into the cylinders.

Air free of abrasive particles reduces the wear on cylinder walls, piston rings, rod bearings, and valves. If these abrasive particles are not removed, damage is done to the engine before the dust reaches the oil stream, where it is removed by the oil filter.

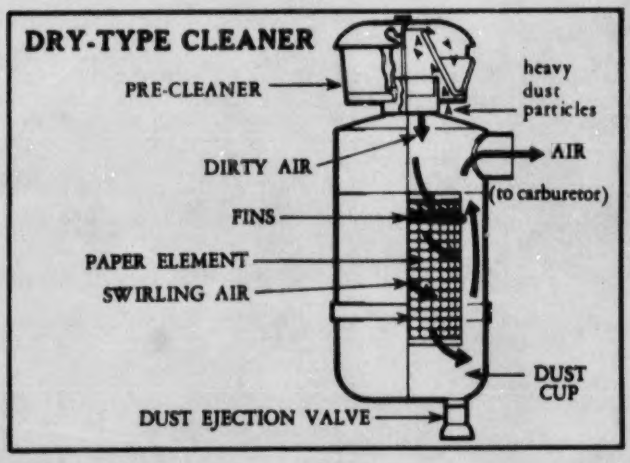
The average tractor mixes 9,000 gallons of air (by volume) per gallon of fuel used under normal operating conditions. All air enters the carburetor after passing through the air cleaner.

2. TYPES OF AIR CLEANERS

The oil-bath type air cleaner is common on tractors that require large amounts of air for operation. The method in which the cleaner functions is as follows: incoming air flows into the cleaner oil cup; air forced on the oil causes a mixture of air and oil spray to be carried up into the separating element which is made up of baffles and metal mesh; the fine dust particles carried by the air are trapped by an oil film as the air changes directions many times in the separating element; the dust particles are washed from the screen into the oil cup by the oil spray, and, the dirt particles settle to the bottom of the cup as the clean air passes upward through the filtering element into the engine.



The dry-type air cleaner is either attached to the carburetor or manifold. The filter media is either heavy treated paper, layers of cloth, or felt. The filtering area is increased in the filtering element by the material being folded like an accordion. Dry type air cleaners were used only on small engines several years ago, but today are used on larger engines. The parts of the air cleaner are: inlet pipe, air cleaner body, filter element fins, baffles, and dust cup. Many tractors are equipped with a pre-cleaner located at the end of the inlet pipe. Large particles of dust are removed and deposited into a collector bowl before they pass into the main cleaner. The pre-cleaner extends the cleaning intervals by reducing the load



on the main cleaner. Clean air is produced in the dry-type cleaner in the following manner: air enters the element through the air inlet; the design of the element fins causes the air to circulate in a centrifugal motion around the element; as the air reaches the bottom of the element, the dirt is separated and deposited into the dust cup; and, finally as the air flows through the filter element, the remainder of the foreign material is removed.

3. ADVANTAGES AND DISADVANTAGES OF DRY AND OIL-BATH CLEANERS

Many tractors are equipped with an air cleaner restriction gauge to indicate when the air cleaner needs servicing. Otherwise, routine service intervals must be followed. In case the filter is not serviced as recommended, the air movement through the filter will be restricted, causing the engine to lose power, give off black smoke, and use more fuel.

The dry type of cleaner does not require cleaning as often. The oil-bath type cleaner is cleaned daily, whereas the dry type cleaner is cleaned at 50-hour intervals.

The dry element may be cleaned with air and/or water eliminating the use of a solvent; therefore, it is not as messy as cleaning the oil-bath type filter. The dry element also is less likely to have clogged air passages.

4. SERVICING THE OIL-BATH TYPE AIR CLEANER

The oil-bath type air cleaner should be inspected after each ten hours of operation. It is a good practice to inspect the air intake stack at the same time the oil cup is being inspected.

CLEANING OIL-BATH CLEANER PARTS

The steps to follow in servicing the oil-bath type air cleaner are:

a. Stop the engine to prevent dust particles from being drawn into the engine during servicing of the air cleaner.

b. Remove the oil cup and inspect for a dirt deposit. If the accumulation of dirt is about one-fourth inch deep or the oil appears heavy, it should be emptied, cleaned with a solvent, and refilled with the proper grade of oil. Always maintain the proper oil level.

c. Properly flush the element and remove any foreign material from the screen before replacing the oil cup.

5. SERVICING THE DRY-TYPE AIR CLEANER

The following steps should be followed in servicing a dry-type air cleaner:

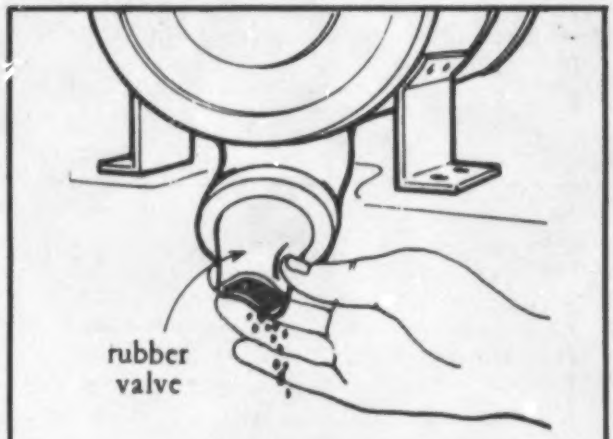
a. Stop the engine before servicing the air cleaner to prevent dirt or dust from being drawn into the engine.

b. If the air cleaner is equipped with a dust unloader valve, it should be opened to release the dust particles. Replace the unloader if it is damaged.

c. It may be necessary to remove the hood or grill to provide access to the air cleaner.

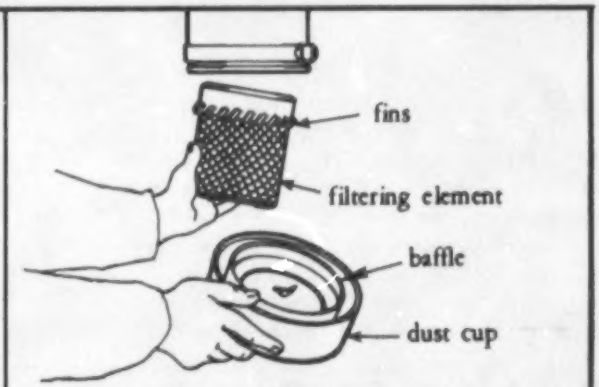
d. The dust on the exposed end of the air cleaner should be wiped off with a rag before removing the element.

e. The end cap may be held in place by a hand screw or clamp. To free the cap, remove the screw or clamp.



DUST UNLOADER
(rubber valve type)

REMOVING DUST CUP



REMOVING FILTERING ELEMENT

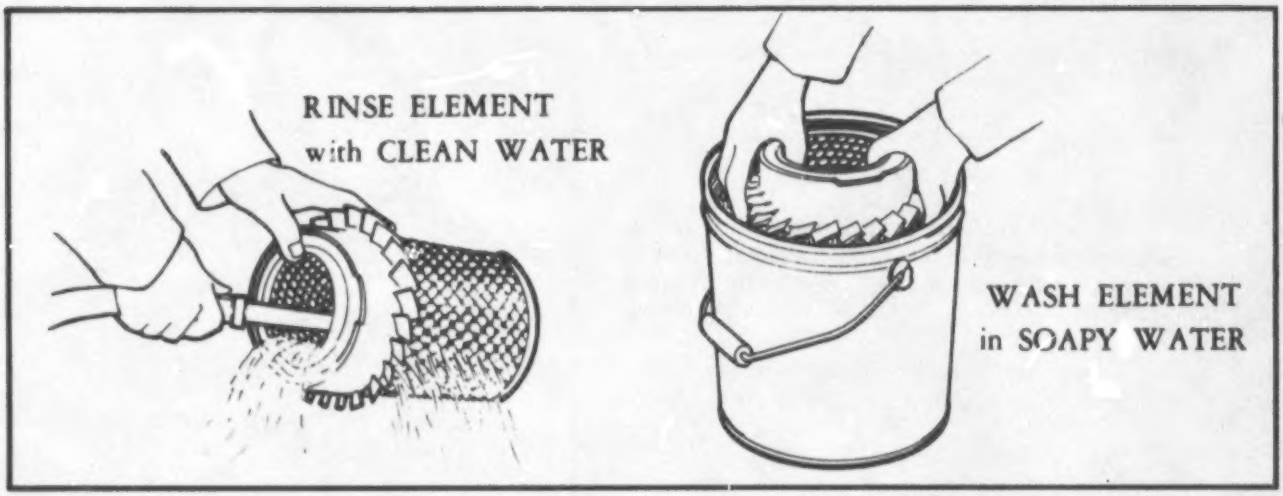
f. A clean rag should be used to wipe the area around the element and to remove the dust from both the cup and baffle.

g. If the rubber gasket on the end of the filter element is damaged, the entire filter element must be replaced.

h. After the filter element is removed and examined for defects, it should be cleaned, unless the element is to be replaced. To clean the element, lightly tap it against the hand or work bench to loosen the dirt, then place the nozzle of a compressed air hose about one inch from the inner side of the element and rotate until clean. Care should be taken not to puncture the element with excessive air pressure.

TAP ELEMENT
TO LOOSEN
DIRT

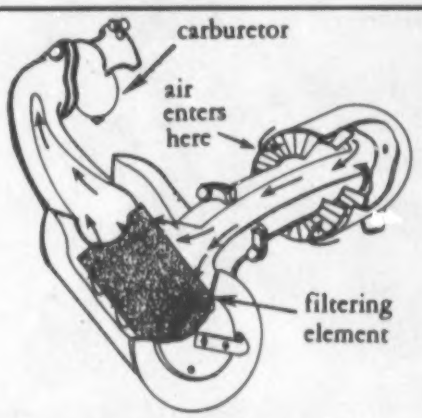
USE AIR TO
REMOVE DIRT



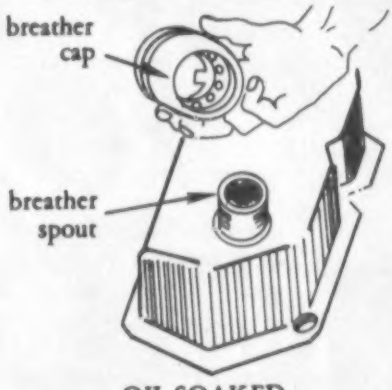
After cleaning away the dirt, wash with warm soapy water, rinse with clean water, and allow 24 hours for drying. Cleaning is now completed and the air cleaner can be reassembled in reverse order of disassembly.

6. SERVICING THE OIL-SOAKED ELEMENT

The oil-soaked element type air cleaner is found on small tractor engines that require large amounts of air. This type of air cleaner requires frequent attention, although it need not be checked daily. In servicing this filter, stop the engine, remove the element and wash it in a safe solvent. Shake the element to remove excess solvent, and allow it to dry thoroughly before soaking it in oil. Replace the element correctly. Breather caps on some engines should be cleaned and dried in the same manner.



OIL-SOAKED CLEANER



OIL-SOAKED
CRANKCASE BREATHER

7. THE PURPOSES OF LUBRICATION

The five major purposes for lubricating tractors are:

a. To lubricate moving parts. Oil and grease reduces friction to a minimum, by supplying a layer of oil between the moving parts. A proper layer of oil will actually separate wearing parts.

b. To assist in cooling moving parts. The pistons, wrist pins, main and connecting rod bearings depend upon the circulation of oil as a cooling agent. Oil removes heat from the moving parts of an engine and transfers it to cooler oil and metal surfaces. These surfaces transfer the heat outside the engine.

c. To act as a seal. Oil prevents the combustion gases from leaking past the piston rings which aids in the elimination of power loss. The seal may function as a cushion when metal parts are in contact with each other under great amounts of pressure. For example, on the power stroke of an engine, the oil film prevents metal-to-metal contact by absorbing the force created by the stroke.

d. To keep the moving parts clean. Soots and other contaminants are carried away in the oil to a filter where they are picked up and held. Other contaminants are held in suspension in the oil and eliminated when the crankcase is drained. In keeping the engine clean, oil acts as a carrier for corrosion and rust additives that are provided for these purposes.

e. To eliminate power loss caused by friction. Friction between metal moving parts is reduced if enough oil is present to provide viscous friction (friction between the molecules of oil).

8. CLASSIFICATION AND GRADES OF OIL

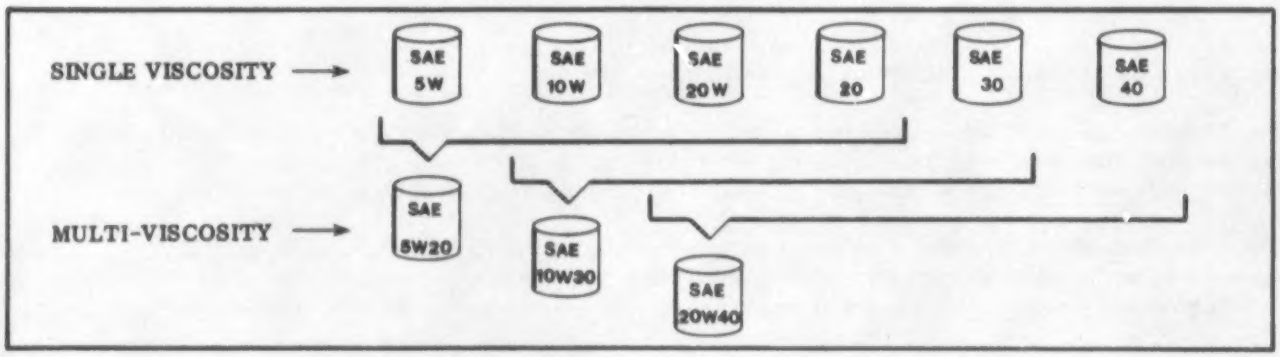
The classification and grades of oil are based upon the oil properties. One of the most important properties is the body of the oil (viscosity). Oil's viscosity is determined by its ability to flow through a standard size opening at a given temperature.

a. The SAE (Society of American Engineers) Viscosity Classification system was adopted in 1926, to recommend motor oils to meet temperature requirements, design, and service affecting viscosity. Such properties as color and additives are not covered by this system.

Oils are classified into grades which are based on viscosity tests. Multi-grade oils do not become thin when they are heated. These oils have the ability to resist thickening in low temperatures. However, all oils thicken to a degree when the temperature decreases. Oils thin somewhat when the temperature increases.

The following illustration shows SAE classification of crankcase oils:

SAE VISCOSITY NUMBERS



b. The API (American Petroleum Institute) system of classifying lubricating oil was developed on the basis of engine requirements under certain types of working conditions as shown in the following chart:

Summary of Current Equipment Manufacturer Recommendations		
Application	API Performance Classification	Current Common Name
Gasoline Engine Passenger Car	SE	MIL-B
Gasoline Engine Truck	SE or CC	MIL-B
Diesel Engine Truck or Tractor	CB, CC, or CD	Supplement - 1 MIL-B Series 3 (S-3)

9. TYPES OF GREASES AND SERVICE TIPS

Greases have two main ingredients, oil and soap-type thickening agents. Greases range from very soft to very hard consistencies. The three most common types of soap thickeners used in grease are:

a. Lime Soap Greases - These greases are used in a pressure gun to grease the chassis. They are not recommended on parts where the temperature exceeds 190°F. Lime soap greases are resistant to water.

b. Soda Soap Greases - These greases are made to withstand high temperatures, but they are not resistant to water. Soda soap greases are used on wheels and/or ball bearings.

c. Lithium Soap Greases - These greases are used extensively for greasing tractors. They are resistant to both heat and water, thus they are considered as multi-purpose greases. Some lithium soap greases contain additives with rust protection and pressure properties.

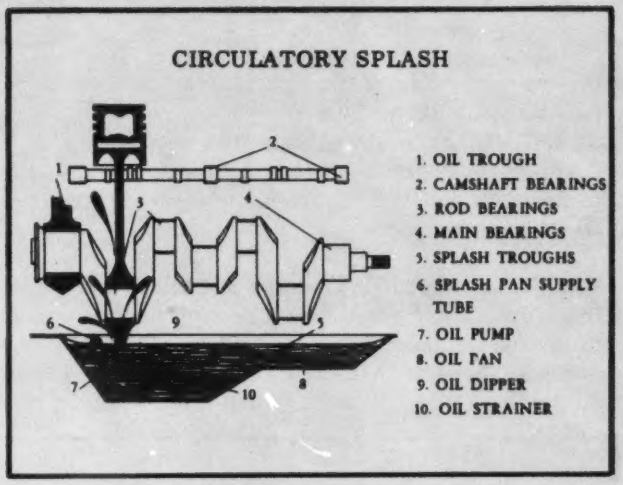
The operator's manual is used to determine when and how to grease the tractor. Tractors working under moist or dusty conditions need lubricating more frequently than tractors working under ideal conditions. It is very important to use the right type and right amount of grease. Some working parts (steering system) are enclosed in a rubber container that may be damaged if too much grease is added at one time. All grease fittings should be wiped clean before applying grease with the grease gun. Grease must be free of impurities. Abrasive dust particles can destroy a bearing in a very short time.

10. TYPES OF ENGINE LUBRICATION SYSTEMS

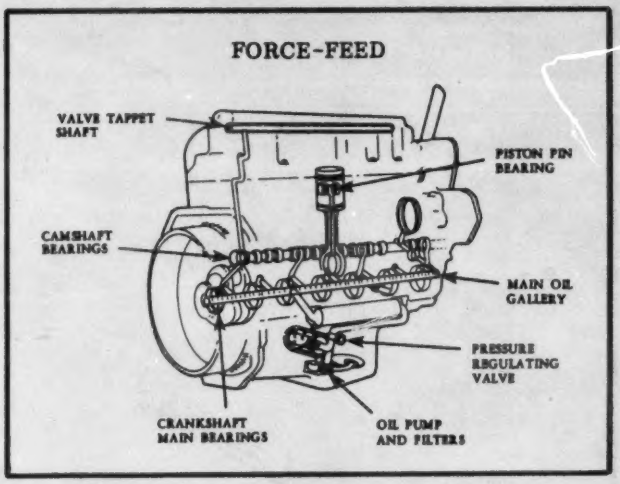
The oil carried in the crankcase of a tractor engine lubricates the following parts by circulating and splashing the oil: main bearings and connecting rod bearings; cylinder walls, piston rings, piston pins, and pistons; camshaft bearings, cams, valve lifters, and valve guides; governors and injection pumps.

The common types of lubrication systems are: splash, circulating-splash, and force-feed. The splash system was used in earlier tractors. Oil was splashed to the working parts in the engine by cups, dippers, or troughs in the engine. This lubrication system is still used on small one-cylinder engines.

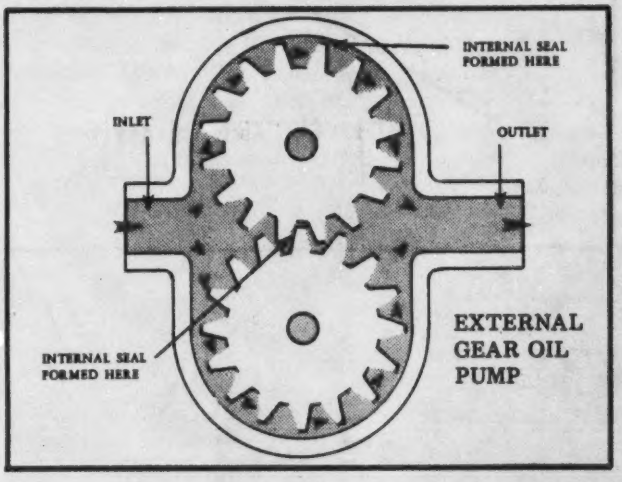
The circulating-splash system operates as a result of an oil mist being splashed to parts of the engine by the ends of the connecting rods as they revolve through the splash pan troughs. Oil is supplied to the troughs by an oil pump located in the crankcase. Some channeling and piping to lubricate the bearings are found in the circulating-splash system.



The force-feed system may be identified as a modified circulating-splash system, unless it is complete force-feed. An oil pump picks up oil and forces it to the various parts of the engine. Oil passes from the main line to the main bearings, oil filter, and oil gauge. The secondary line lubricates the cam, idler gear, and timing gear. The third line, if present, lubricates the valve system. The connecting rods do not dip into troughs in this lubrication system. The relief valve maintains approximately 15 pounds of pressure, thus the oil is forced to most moving parts by pressure.



Pumps for engine lubrication are usually gear types, mechanically driven by the engine camshaft or crankshaft. The pumps push oil through the system and also trap the oil so that oil pressure can be maintained in the system. The common external gear pump has two gears in mesh, closely fitted inside a housing. The drive shaft drives one gear, which in turn drives the other. The outer housing has machined surfaces that are used to seal the gears. As the gears rotate and come out of mesh, they trap the inlet oil between the gear teeth and the housing. The trapped oil is forced around to the outlet chamber. As the gears mesh again, they form a seal which prevents the oil from backing up to the inlet. The oil is forced out at the outlet and sent through the system.



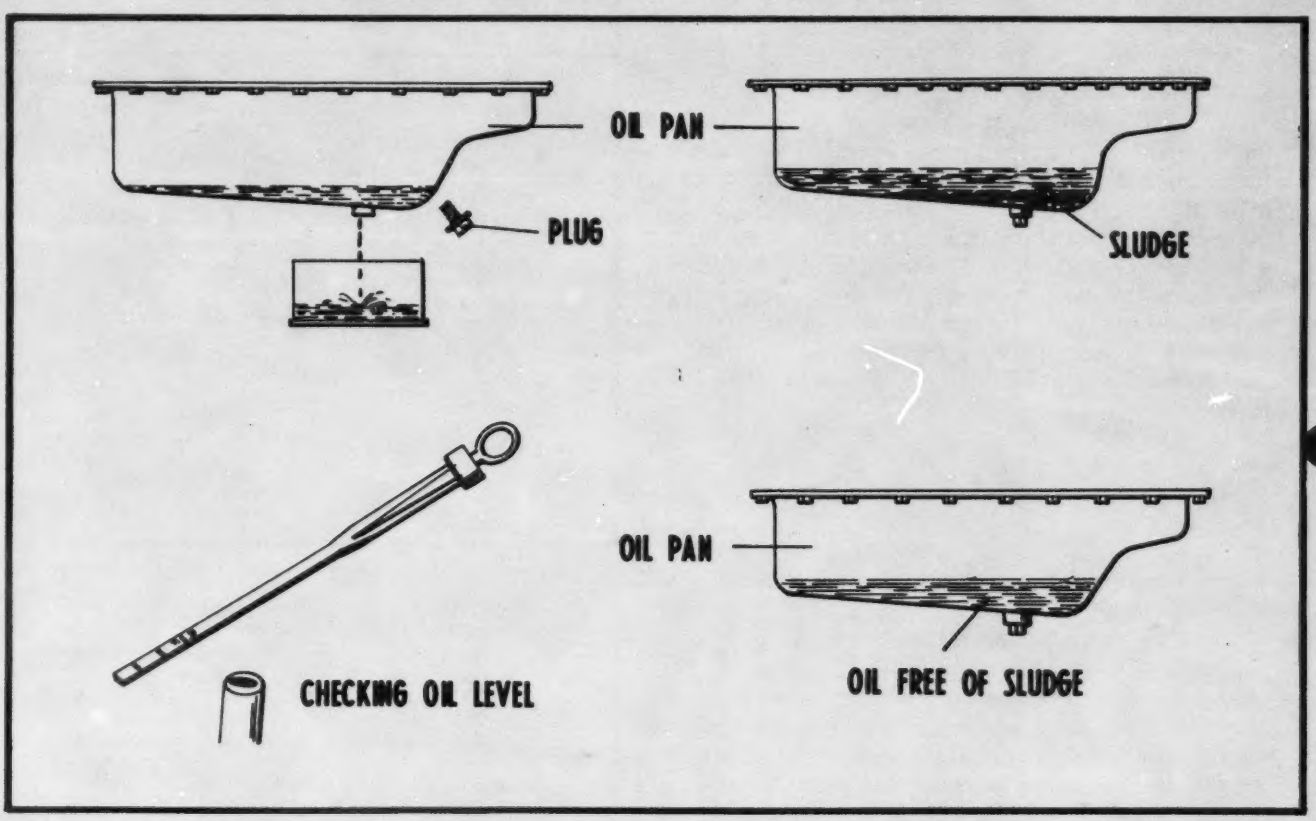
11. CHANGING THE CRANKCASE OIL

Lubricating oils "wear out" and lose their lubricating qualities when the additives become depleted and the oil becomes dirty. Oils are contaminated with sludge, varnish, acid formations, fuel soot, and gasoline. To insure long engine life, oil should be checked and changed frequently. A tractor starts and stops often,

causing it to burn more oil than vehicles which travel long distances without frequent starts and stops.

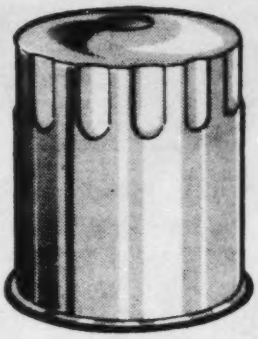
Crankcase oil should be drained while the oil is warm; therefore, remove the oil immediately after using the tractor. More of the dirt, sludge, and other contaminants will be removed if they have not had a chance to settle out. If the tractor is stored, new oil should be added at the beginning of the storage period. Fresh oil will eliminate sludge and dirt settling out in the crankcase. During the winter months water will accumulate in the crankcase if the tractor is not allowed to run until a normal temperature is reached. Most modern tractors are equipped with ventilation systems which dispose of the unburned fuels and water in the crankcase.

When changing the crankcase oil, follow the manufacturer's recommendations on procedure, interval, and the type of oil to use. The following factors will influence the changing of engine oil: hours used between oil changes; color of the oil (dark oil may still have body and film-forming ability); content of water, sludge, abrasive materials, and other contaminants; length of idle periods; short-running periods during cold winter months; and, use of the tractor on dusty and dirty types of jobs.

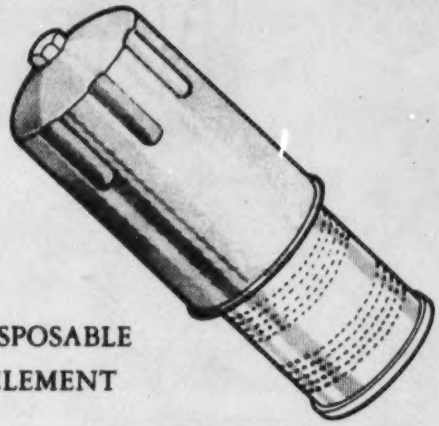


12. CHANGING THE OIL FILTER

The purpose of the oil filter is to remove the impurities (abrasives and other foreign materials) from the oil. Most tractors are equipped with oil filters. The two most common types of filters found on tractors are the surface and depth filters. The entire filter may be disposable or only the element may be disposable.

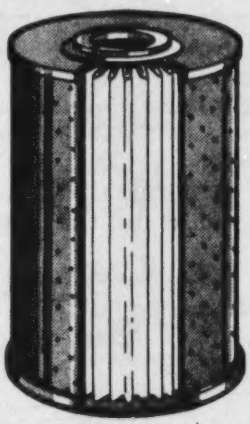


DISPOSABLE FILTER



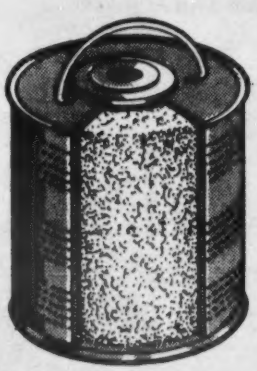
DISPOSABLE ELEMENT

The surface filter strains the particles of dirt as the oil passes through a straight line path through the holes. The holes are smaller than the dirt particles; therefore, as the particles hit the surface, they fall into the filter reservoir. These filters are made of wire mesh, stacked metal or paper disks, or accordion-pleated paper.



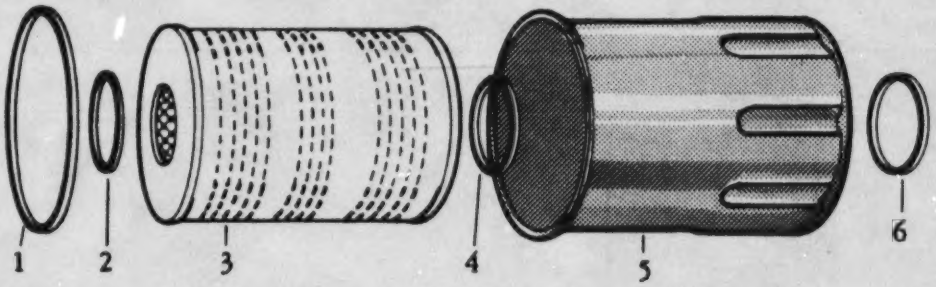
SURFACE FILTER

The depth filter is either absorbent or adsorbent. The absorbent filters will trap porous materials, soak up water, and soak up other impurities. The cotton, wool, wood, or paper materials reacts like a sponge that takes in water. The adsorbent filters are chemically treated so they attract and remove impurities.



DEPTH FILTER

The parts of the disposable element filter are illustrated here:



1. HOUSING GASKET
2. GASKET
3. FILTER ELEMENT
4. GASKET
5. FILTER HOUSING
6. GASKET

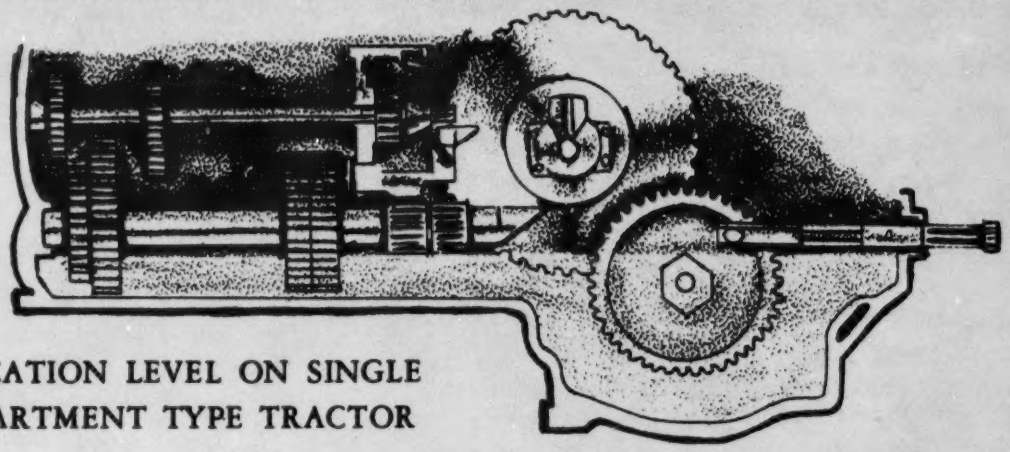
Servicing most filter systems is accomplished by replacing the removable cartridge or element. Some makes of tractors have filter elements contained in a removable housing. The housing and mounting base in this type of filter should be cleaned with a solvent and dried with compressed air. If the relief valve is removable, it should also be cleaned and dried.

Metal filters (edge-type) should be soaked in lye water if the filter has a varnish-like substance on it. In most cases a metal filter can be cleaned with solvent and a brush.

When servicing a filter, new gaskets and rings should always be used. It is usually recommended that the filter be changed at the same time the crankcase oil is changed. The engine should be allowed to run until adequate oil pressure registers on the gauge, then checked for leaks.

13. LUBRICATION OF TRACTOR TRANSMISSION AND PTO DRIVES

Transmission care is equally as important as lubricating other parts of the tractor. The lubricant level should be properly maintained. The lubricant in the gear case is splashed, pumped, or splashed and pumped to all working parts.



LUBRICATION LEVEL ON SINGLE COMPARTMENT TYPE TRACTOR

Gear lubricants undergo the same changes as engine lubricants. Oxidation and thickening may take place and the additives may become depleted. Fine dust, moisture, and metal particles are examples of contaminants found in transmissions.

Transmission lubricant should be changed only when the oil is warm. If the transmission is to be flushed after it is drained, kerosene or diesel oil should be used. Flushing is accomplished by filling the gear case with the thin lubricant and then driving the tractor for a few minutes before draining and filling with a new lubricant. Some transmissions have more than one drain plug. The operator's manual explains the interval and lubricant that should be used.

SUGGESTED STUDENT ACTIVITIES

I. Fill in the blank.

1. The average tractor mixes _____ gallons of air (by volume) per gallon of fuel used under normal operating conditions.

2. The separating element in the oil-bath type air cleaner is made up of _____ and metal mesh.

3. The filtering media in the dry-type air cleaner is made of heavy treated paper and folded like an _____.

4. Failure to properly service the air cleaner results in loss of _____, engine giving off black smoke, and using more _____.

5. When servicing the air cleaner, _____ the engine to prevent foreign materials from being drawn into the engine.

6. Use compressed air to blow from the _____ side of the dry-type air cleaner and rotate until clean.

7. Oil's _____ is determined by its ability to flow through a standard size opening at a given temperature.

8. The _____ _____ _____ system of classifying lubricating oil was developed on the basis of engine requirements under certain types of working conditions.

9. Greases have two main ingredients, _____ and _____ thickening agents.

10. Crankcase oil should be drained when the oil is _____.

II. Define, identify, or discuss.

1. Oil-bath air cleaner -

2. Dry-type air cleaner -

3. Pre-cleaner -

4. Service interval -

5. SAE -

6. API -

7. Multi-viscosity oil -

8. Lithium soap grease -

9. Circulating-splash lubrication -

10. Force-feed lubrication -

11. Oil pump operation -

12. Surface oil filter -

13. Depth oil filter -

14. Lubricant contaminants -

III. Discussion.

1. Servicing the air cleaner.

2. The purposes of lubrication.

3. Classification and grades of oil.

4. Greasing the tractor.

5. Changing the oil and filter.